Response to Restriction Requirement

Applicants confirm election of the invention defined by Group I as set forth in the Examiner's March 1, 2005 paper. Applicants' traverse is withdrawn.

Claim Rejections – 35 U.S.C. § 112

The Examiner's rejection of Claim 6 in that it recites the limitation "substrate (a) or (c)" in line 1 has been rendered moot in view of the cancellation of the claim.

Claim Rejections – 35 U.S.C. § 103

The rejection of claims 1-8 (now 105 and 8) under 35 U.S.C. 103(a) as being unpatentable over slaney et al. (U.S. 6,346,640) and Drent et al. (EP 0 495 547 A2), each taken alone, is respectfully traversed, especially in view of the amendments made to the claims. The differences between the cited prior art references and the process described in the amended claims are more significant than what is set forth by the Examiner as the scope and content of the prior art.

Slany et al. is believed to be the closest art although the teaching in the earlier Drent disclosure appears to describe the reaction of 3-pentenenitrile (3PN) with carbon monoxide (CO) and methanol (MeOH) as set forth in Slany et al.'s Examples 1-4. In fact, the R group, X group, and suitable bidentate diphosphine ligand, $R^1R^2P\text{-}X\text{-}PR^3R^4$, descriptions in col. 2, line 51 through col. 3, line 51, are virtually identical to the descriptions in Drent et al. Unlike the instant application, Slany indicates that organic acid promoters having a pKa value of 3.5 or higher are preferred.

Examples 1-4 of Slany et al. (i) set the bar for selectivities to the desired product, $NC\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CO_2R'$ (5-cyanovaleric acid ester when R'OH is the nucleophile, 5CVE) at 70-72% and (ii) teach that catalyst activity can be improved by use of a defined, prepared palladium diphosphine complex. Applicants can find no teachings within Slany et al. to suggest the two discoveries embraced within Group I:

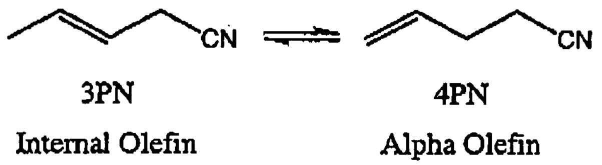
A. Method to significantly improve the selectivity to this $NC\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CO_2R'$ product (72% to 96%) by changing the catalyst (diphosphine ligand and acid promoter); and

B. Use of a mixed promoter catalyst system (strong acid and carboxylic acid) when the nucleophile is water that improves reaction rates to $NC\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CO_2H$.

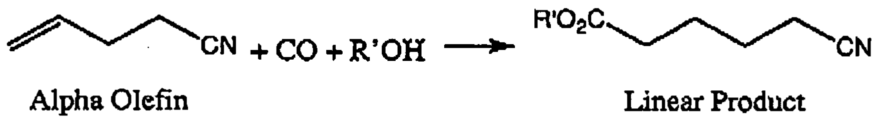
Although Drent et al. may encompass the "monocarbonylation" of a wide range of olefins with the similar ligand, i.e., palladium, and stronger acid promoters (relative to Slany et al.), the description and Examples shed very little light on the catalyst's performance to react an internal olefin, like 3PN, with CO and MeOH or water to form the compounds of Slany et al. and the instant application, NC-CH_2-CH_2-CH_2-CH_2-CO_2R'. Drent et al. focuses instead on alpha olefins and the majority of the Examples, especially utilizing the strong acid promoters, involve different types of carbonylation reactions (olefin hydroformylation or dimerization with CO and H_2) producing different types of products (aldehydes and ketones, respectively). Only Examples 13d and 37 shed any light on what might be possible with the Drent et al. catalyst's ability to convert an internal olefin to a linear ester or carboxylic acid product.

Example 13d uses methyl 3-pentenoate (M3P) as the olefin substrate with a palladium catalyst derived from 1,3-bis(di-sec-butylphosphino)propane and tert-butylsulfonic acid promoter. The selectivity to the linear diester product, dimethyl adipate, is 84% at 80% M3P conversion after 5 hours at 115° C. Besides having 15% lower selectivity to the linear product as compared to the instant application (see Example 3), one skilled in the art reading the Drent et al. patent alone would not understand whether or not hydrogen has an impact on the catalyst performance in this reaction. Hydrogen is not a component of the instant invention.

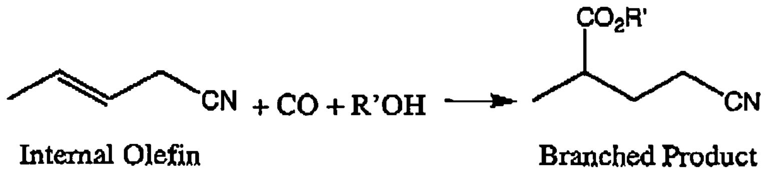
Example 37 uses 1-octene as an alpha olefin substrate with a palladium catalyst derived from 1,3-bis(di-isopropylphosphino)propane and 2,4,6-trimethylbenzoic acid promoter. Although this olefin is not an internal olefin like 3PN, it will not provide one skilled in the art with an expectation of the highest selectivity to a linear product like NC-CH_2-CH_2-CH_2-CH_2-CO_2R' with such a catalyst system for the reason that a catalyst capable of carbonylating an internal olefin with high selectivities to a linear product usually accomplishes this task by the reaction sequence shown below. Unlike a catalyst for the carbonylation of alpha olefins, the catalyst for internal olefins must have the added ability to isomerize the internal olefin (3PN) to the corresponding alpha olefin (4-pentenenitrile) as shown in Equation (1). Selective carbonylation of the alpha olefin will then yield the highest selectivities to the desired linear product (Eqn. (2)) whereas any carbonylation of the internal olefins will result mainly in the formation of branched products, like 4-cyano-2-methylbutyric acid esters (Eqn. (3)). In the Drent et al. Example 37, the selectivity to the linear ester product, ethyl nonanoate, is only 84% at a turn-over-frequency (TOF) of 100 at 135° C. One skilled in the art would conclude that (1) this linear selectivity would be an upper limit for the carbonylation of a similar internal olefin and (2) the linear selectivity for carbonylation of a similar internal olefin would very likely be lower due to the catalyst having some activity for carbonylation of the internal olefin to the branched ester product (Eqn. (3)). In fact, the selectivity for 3PN carbonylation to methyl 5-cyanovalerate disclosed in Slany et al. is 12% lower than the 84% for 1-octene in Drent et al. Hence, the 96% selectivities reported for the improved catalysts of the instant invention are clearly unexpected in view of the teachings of Slany et al. and/or Drent et al.



(1)



(2)



(3)

Although some of the other Drent et al. (olefin+CO+ROH) Examples (28-36, 38-45, 48-59) may have very high linear selectivities to ester products, they do not suggest the instant invention as set forth in the amended claim. The examples either use ethene as the olefin substrate, that can only form a single ester product (e.g., alkyl propionates), or vinyl compounds, wherein formation of the branched product is highly disfavored for steric reasons. Hence, the selectivities to linear ester products are extremely high (98%) from ethene and these vinyl compounds, similar to the present invention for the carbonylation of an internal olefin (96%), because no other ester product can be formed. Therefore, the Drent et al. olefin+CO+ROH examples also do not suggest or teach a method to significantly improve the selectivity to the $NC-CH_2-CH_2-CH_2-CH_2-CO_2R'$ product by changing the catalyst (diphosphine ligand and acid promoter).

It is universally accepted within the scientific discipline of catalysis that it is difficult to predict *apriori* the outcome of an organic reaction involving a catalytic species, as small changes in the ligand, promoter, etc. comprising said catalytic species can have significant effects on, for example, the reaction rate and selectivity and/or yield to a desired product. Catalyst performance for the same internal olefin substrate, 3-pentenenitrile, disclosed in the instant examples far exceeds those disclosed in Slany et al., not just in terms of selectivity to the desired product, NC-CH_2-CH_2-CH_2-CH_2-CO_2R', but also in terms of reaction rate.

The Examiner's attention is invited to the comparison of the examples from Slany et al., the instant application, and Drent et al. set forth in the table which follows. With Ligand 1, Applicants' Example 3 (Table 1) and Example 5 (Table 4) illustrate selectivities of 95-96%, whereas Slany et al. Examples 1-4 (Table in Column 8), with different ligands and promoters, illustrate selectivities of 70-75%. Slany et al. also require 150°C to obtain reaction rates comparable to those obtained in Applicants' examples at 100°C. A 20-25% increase in selectivity and/or yield to the desired compound is not minor – rather, it is significant, unexpected, and inventive. In view of the foregoing remarks and the amendments to the claims, reconsideration and withdrawal of the rejection is respectfully requested.

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US 6,346,640	Reactants	Temperature	CO Pressure (psig)	Reaction Time (Hours)	Mol 3PN/ Mol Pd	Acid	Mol Acid/ Mol Pd	3PN Conversion (%)	Selectivity CVE (%)	Selectivity 5-CVE (%)	TON	TOF (TON/Hour)
Example 1	3PN+CO+MeOH	150°C	870	8	248	9AnCO2H	16		90	70	192	32
Example 2	3PN+CO+MeOH	150°C	870	15	248	9AnCO2H	4		40	71	85	14
Example 3	3PN+CO+MeOH	150°C	870	3	824	9AnCO2H	16		57	72	470	157
Example 4	3PN+CO+MeOH	150°C	870	3	824	9AnCO2H	16		62	72	494	165
Instant Case												
Example 3	3PN+CO+MeOH	100°C	500	5	1703	MeSO3H	1.9	97.6	96	96	1596	314
Example 4	3PN+CO+MeOH	100°C	500	4	1703	MeSO3H	1.9	81.9	72	93	1004	83
Example 5	3PN+CO+H2O	100°C	500	6	511	MeSO3H+ MeCO2H	2	66	95	97		44
EP 0495547					Mol 1-Octene/ Mol Pd				Selectivity C9 Ester (%)	Selectivity Ethyl nonanoate (%)		
Example 37	1-Octene+CO+EtOH	135°C	725	1 to 5 ?	510	Me3BzCO2H	40		98	84		100

The amended claims are set forth and commence on a separate sheet(s).

It is believed that the foregoing amendment and remarks constitute a complete response to the Examiner's Action of August 16, 2005 and place the amended claims in condition for allowance. Should the Examiner believe that an interview or some other action in Applicants' behalf would expedite prosecution of the application, he is urged to contact Applicants' attorney by telephone. It is not believed that any fees are due by reason of this Amendment, however, if such fees are required, please charge deposit account 503223 (Invista North America S.à r.l.).

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Respectfully submitted,

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